

REMARKS

The abstract and specification have been amended in order to correct grammatical and idiomatic errors contained therein. No new matter has been added.

In order to more particularly point out and distinctly claim the subject matter that Applicant regards as the invention, Claim 1 has been amended to state that the catalyst comprises an amorphous zirconium oxide and at least one oxide selected from the group consisting of aluminum oxide, phosphorus oxide and titanium oxide. Claim 5 has been canceled. Newly presented Claims 10 and 11 are directed to specific embodiments of the present invention. No new matter has been added.

Claims 1 and 2 have been rejected under 35 USC 102(b) as being anticipated by Kumar et al. Claims 1-9 have been rejected under 35 USC 103(a) as being unpatentable over Bayense et al, Putzig and Putzig et al. Applicant respectfully traverses these grounds of rejection and urges reconsideration in light of the following comments.

The presently claimed invention is directed to a method for the manufacture of an ester by transesterification which comprises the step of bringing a starting material ester and an alcohol into contact with a catalyst comprising an amorphous zirconium oxide and at least one oxide selected from the group consisting of aluminum oxide, phosphorus oxide and titanium oxide.

As discussed in the present specification, in conventional transesterification reactions, when an alkali catalyst, such as caustic soda, is used, the resulting transesterification reaction time is long and the catalyst has to be removed from the reaction product after the reaction. Additionally, when the starting materials contain a large quantity of fatty acid esters, a pretreatment is required to remove them. Another problem was that the transesterification reaction could not proceed due to a saponification reaction

and when a zinc catalyst was used or when the reaction proceeded under supercritical conditions, the reaction typically had to be conducted under a pressure as high as 5 to 8 MPa.

The present invention overcomes the problems associated with the prior art transesterification reactions by providing an inventive transesterification reaction which can be conducted in a short period of time under a pressure on the order of a normal pressure. Additionally, the product and catalyst can easily be separated from each other which results in the product ester being produced with a higher efficiency. It is respectfully submitted that the prior art cited by the Examiner does not disclose the presently claimed invention.

The Kumar et al publication discloses a procedure for transesterificating β -keto esters using a yttria-zirconia based Lewis acid catalyst. This reference further discloses that yttria-zirconia based Lewis acid catalysts are efficient in selecting the transesterification of β -keto methyl or ethyl esters by different alcohols. Since this reference is concerned with the selective effectiveness of yttria-zirconia catalysts in transesterification reactions of β -keto esters and the ineffectiveness of the catalysts in the transesterification reaction of other esters, this reference does not teach catalysts, other than yttria-zirconia catalysts, that a catalytic activity in the transesterification reaction of β -keto esters and other esters.

The presently claimed invention requires that the catalyst comprise an amorphous zirconium oxide and at least one of aluminum oxide, phosphorus oxide and titanium oxide. Additionally, yttria is not required in the catalyst of the present invention while it is essential in the catalyst composition of Kumar et al. Kumar et al also does not require that amorphous zirconium oxide be used nor suggest that there would be any advantage of using amorphous zirconium oxide over crystalline aluminum oxide.

As discussed previously, Kumar et al states that, at page 251, right column, lines 26-30, "It is important to mention that the reaction appears to be specific only for the transesterification of β -keto esters. Other esters like α -keto esters, γ -keto esters, unsaturated esters as well as normal esters fail to undergo the reaction." This indicates that the applicability of the catalyst of Kumar et al is extremely selective and limited only to the transesterification of β -keto esters and any teaching contained in this reference cannot be extended to other transesterification reactions. As such, it is respectfully submitted that the presently claimed invention clearly is patentably distinguishable over this reference.

The Bayense et al reference is directed to a process for transesterifying carboxylic acid esters utilizing a catalyst comprising at least one silicate of a Group IV B element as an active component of the catalyst. Of the Group IV B silicates, titanium and zirconium are preferred with titanium being especially preferred. The silicates are disclosed as being either crystalline or amorphous. There is no specific example of using a zirconium silicate catalyst.

As discussed previously, the catalyst of the present invention contains an amorphous zirconium oxide and at least one of aluminum oxide, phosphorus oxide and titanium oxide. It does not contain silicon and the zirconium and titanium compounds in the present catalyst are not present in the form of a silicate. Additionally, the Bayense et al reference has no disclosure with respect to using amorphous zirconium oxide or suggest that any advantage would be gained by using amorphous zirconium over crystalline zirconium in the catalyst. As such, this reference does not even make a showing of prima facie obviousness under 35 USC 103(a) over the presently claimed invention.

Putzig '170 discloses a catalyst composition used in producing an ester or a polyester through the contact of a carbonyl compound with an alcohol. The catalyst composition

comprises a titanium compound, a complexing agent, hypophosphorus acid or its metal salt, water and, optionally, a solvent. This reference further discloses that the ester or polyester may have less of an undesirable color, which could occur in the case of using an organic titanate catalyst alone, and without plugging fiber spinnerets. As the titanium compound, this reference discloses organic titanium compounds including those expressed by the formula $Ti(OR)_4$, as preferred examples. Titanium tetrahydrocarbyloxiide can be combined with a zirconium tetrahydrocarbyloxiide. In this reference, the titanium and zirconium compounds which can make up the catalyst are all organometallic compounds in contrast to the inorganic components of the catalyst of the present invention.

The catalyst of the present invention is distinguished from that of Putzig '170 in that the inventive catalyst requires an amorphous zirconium oxide and at least one of aluminum oxide, phosphorus oxide and titanium oxide, with these components all being inorganic compounds. In contrast thereto, the catalyst components of Putzig '170 are organometallic compounds of titanium and, optionally, zirconium. Additionally, although the organic zirconium compound can be present as an optional catalyst component, this reference has no disclosure with respect to the effect or function of the organic zirconium compound nor presents any specific examples using the organic zirconium compound. Lastly, Putzig '170 has no disclosure with respect to using an amorphous zirconium compound let alone any advantages that would be gained by using an amorphous zirconium oxide over crystalline zirconium oxide. Therefore, it is respectfully submitted that Putzig '170 does not even present a showing of prima facie obviousness under 35 USC 103(a) with respect to the presently claimed invention.

Putzig et al '441 discloses a titanium-containing catalyst composition comprising a titanium compound, a solubility promoter, a phosphorus source, a solvent, and, optionally, a sulfonic acid, a co-catalyst, or both. The

co-catalyst can be a cobalt/aluminum catalyst, an antimony compound, or combinations thereof. The catalyst is used in a process which comprises contacting a carbonyl compound, in the presence of the catalyst, with an alcohol under a condition suitable for esterification, transesterification, polymerization, or combinations thereof. As the solubility promoter, ortho-zirconates are disclosed as well as ortho-silicates and the solubility promoter is used to help dissolve the organic titanium compounds in a solvent used to prepare the composition, at room temperature. Like the previously discussed Putzig '170, this reference discloses organic titanium compounds as the titanium compounds used in the catalyst and, as the zirconates, organic ortho-zirconates. This reference has no disclosure with respect to the use of inorganic titanium and zirconium compounds. Putzig et al '441 also does not disclose any advantage that would be gained by using an amorphous zirconium oxide over a crystalline zirconium oxide in the catalyst composition. Therefore, Putzig et al '441 adds nothing to the disclosure of the previously discussed references and, like the previously discussed references, it does not even present a showing of prima facie obviousness under 35 USC 103(a).

Although the Examiner has stated that the catalyst composition of Putzig et al '441 also comprises aluminum, an antimony compound and combinations thereof, this reference discloses cobalt/aluminum catalysts and not aluminum catalysts per se, antimony compounds and combinations thereof as co-catalysts and these co-catalysts are optionally used in the manufacture of polyalkaline terephthalates. Aluminum is used in combination with cobalt in the co-catalysts while cobalt is not used in the catalyst composition of the present invention. As such, it is respectfully submitted that the presently claimed invention is clearly patentably distinguishable over Putzig et al '441.

Although the references cited by the Examiner have not made a showing of prima facie obviousness under 35 USC 103(a),

objective evidence of the unobviousness of the presently claimed invention is present in the instant specification. In Table 1 on page 9 of the present specification, test examples 1 and 7 correspond to catalyst compositions according to the prior art in which crystalline zirconium dioxide is used in the catalyst compositions. As can be seen by comparing test examples 1 and 7 with test examples 2-6 of the present invention, the catalyst compositions of the present invention have superior conversion rates. This is likewise shown in Tables 2 and 3 where test examples 7 and 18 also use crystalline zirconium dioxide. Once again, inferior results were obtained using these catalysts. This is clearly unexpected in light of the prior art cited by the Examiner and further establishes the patentability of the presently claimed invention thereover.

The Examiner is respectfully requested to reconsider the present application and to pass it to issue.

Respectfully submitted,


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Encl: Replacement Abstract
Clean Substitute Specification
Marked-Up Substitute Specification
Postal Card

136.07/05

METHOD FOR MANUFACTURE OF ESTERS BY TRANSESTERIFICATION

ABSTRACT

~~The object of the present invention is to provide a~~
method for the manufacture of an ester by transesterification,
~~this method allowing~~ allows the transesterification reaction
to proceed within a short reaction time and under a pressure
of the order of normal pressure. It was found that
transesterification proceeds when a starting material ester
and an alcohol are brought into contact with a catalyst
comprising (A) an amorphous zirconium oxide and (B) an oxide
of a Group II element, an oxide of a Group V element, and/or
an oxide of a Group IV element other than zirconium and
hafnium. In this method, it is preferred that the starting
material ester in a liquid-phase state and the alcohol in a
vapor-phase state be brought into contact with a solid acid
catalyst comprising the above components (A) and (B), the
starting material ester be an oil or fat, and the alcohol be
methanol or ethanol. An oxide of titanium, silicon, germanium,
or tin is the preferred oxide of the Group IV element other
than zirconium and hafnium.